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Goulais Lake Fire, Sault Ste. Marie District

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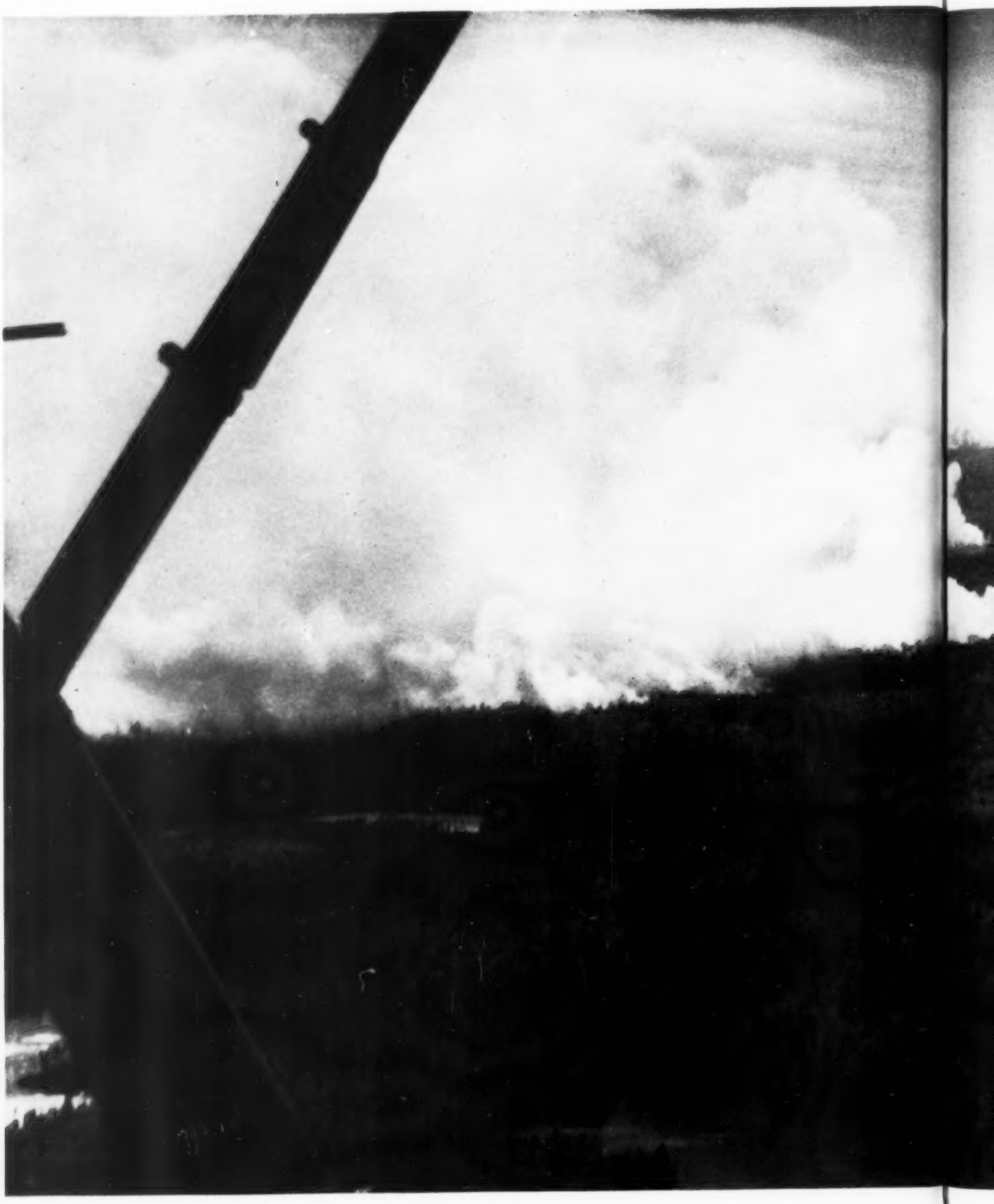


Ontario Department of Lands and Forests photographs.

Forest Protection in Ontario

by W. T. FOSTER

OVER ONE-HALF of the land area of Ontario is forested. This vast growing resource covering over 200,000 square miles is vital to the well-being and prosperity of the people of the province. This forested area provides vast quantities of wood for the huge forest industries of Ontario, a habitat for game and wildlife, and a place of recreation for our people. The forest helps regulate and maintain water flow and prevents erosion. It improves our natural environment and helps modify the climate; it is a priceless asset that can be everlasting only with proper care and protection.

The problem of safeguarding Ontario's forests is a complex one, involving protection from fires, insects and disease. Fire is the greatest menace as it provides a threat to human life and property, but the need for reducing the damage caused by harmful insects and disease is becoming ever more pressing.

It was not until 1849 that the government of Ontario first gave some thought to the matter of forest protection. In this year, a Royal Commission was named to inquire into and study the "Question of the Protection of Forests from Unnecessary Destruction".

In the years that followed other commissions were established to study the problem. If concern was felt, little action was taken; and destructive fires continued unchecked. This was a period of exploitation. The forests stood in the way of progress and development and were thought to be limitless.

It was 1878 when the first fire prevention legislation in Ontario was passed. This was an "Act to Preserve the Forests from Destruction by Fire". By this Act fire districts were established and the use of fire restricted during dangerous periods.

There was now legislation, but not until 1886 were the first fire rangers appointed and posted on timber operations. The cost of maintaining these early rangers was shared equally between

The eastern limits of the Mississagi-Chapleau fire in the early stages. The fire broke out on May 25th, 1948, and raged for over two months.

the government and the timber operator. By 1897 it was found necessary to place fire rangers on other crown lands and the protection system began to grow; 191 rangers were employed in that year.

The efforts of our first fire rangers seem scant, indeed, when compared to today's modern methods, but these men were pioneering. Paid $2.00 a day, which was to cover board and all expenses, a fire ranger was instructed "to travel through his area, warn of the danger of fire and to occasionally select an elevated position to ascertain the locality of any fire". Travel was by foot, canoe, or railway handcar and the tools were a shovel, axe and pail. Often a fire patrol would last two or three months. A few fires were found and extinguished, but many went undetected.

Disastrous fires were still occurring. Notable among these were the Baudette-Rainy River fire, in 1910, in which 42 persons lost their lives; the Porcupine and Cobalt fires, which took 73 lives; and worst of all, the holocaust at Matheson which claimed 224 lives. The government spurred by these disasters and the great loss of life passed the Forest Fires Prevention Act in 1917, and it was only then that an effective system of fire control began to evolve.

Permanent fire rangers were appointed, and a nucleus of a field organization began to take form. A system of fire detection was planned, and fire towers were erected in key locations. Ranger stations and warehouses were established throughout the northern areas of the province, and gradually some mechanized equipment was acquired. The first portable fire pumps had just been developed and a few Model T's and boats were provided for transportation.

The use of aircraft for forestry purposes was studied by the provincial government in the early 1920s, and in 1924 an air service was organized. That year, twenty surplus World War I flying boats were purchased to aid in fire detection and to provide a rapid means of transporting men and equipment to fires.

Forest Fire Losses

Over the past fifty years forest fires have occurred in Ontario at the rate of eight fires per day during the fire season period, April 1st to October 31st. Each fire on an average has burned 220 acres — each day 1,760 acres of forest have burned. Loss of life numbers in the hundreds. Damage to timber and private property amounts to millions of dollars each year.

Fires have always occurred in the forest. Aboriginal people used fire to clear land and to drive game, but rarely used it without some purpose. In the virgin forest, lightning frequently caused fires. These fires are still numerous today causing an average of 250 forest fires a year in Ontario.

The early explorers reported great fires in the past. They are noted in the records of the Jesuit Fathers in the 1600s; Alexander Mackenzie described large fires burning north of Lake Superior in the 1780s and large fires were also recorded in the early diaries of Hudson's Bay Company Factors.

The majority of fires that occur in the forest are readily controlled if quickly attacked by trained fire fighters with adequate equipment. Under certain conditions, however, every small fire is potentially a big fire. Given the proper combination of dry weather, high winds and plenty of fuel, a forest fire may spread with unbelievable violence. It will move as fast or faster than a man can run; it will generate combustible gases, and throw flaming brands a mile

Digging a fire line in the Sudbury District. Fighting forest fires can be dangerous, as well as back-breaking work.

or more in its advance. This is what can happen when a forest fire is "unleashed".

This is what happened in north-western Ontario, on the Minnesota border, when the Baudette-Rainy River fire exploded on October 7th, 1910. It was a combination of four fires driven by a hurricane wind. Three fires were supposed to have been started by a railway locomotive, and one by a settler. Combined, they are known to have burned 300,000 acres and claimed 42 lives.

The following year, 1911, on July 11th it happened again when the Porcupine fire raged over 500,000 acres, destroying parts or all of Timmins, South Porcupine, Porquis Junction, and Cochrane. The actual death toll is unknown, although at least 73 lives were reported lost.

Again it happened in 1916, when, after a prolonged dry spell, the conflagration in the Matheson area occurred. It is reported that this fire burned with incredible violence. The settlements of Kelso, Val Gagne, Porquis Junction, and Iroquois Falls were largely destroyed. The loss of 224 lives makes this the worst forest fire ever recorded in Canada.

The Haileybury fire, which started October 4, 1922, burned over the equivalent of 18 townships, causing 43 fatalities, and 6,000 unfortunate people lost their homes and possessions at the onset of winter.

It happened as recently as 1938 when the Fort Frances fires caused the death of 17 people and burned almost 100,000 acres. It can happen again.

Forest fires that cause this awesome damage are known as "Crown Fires". Other types of forest fires are surface or ground fires. These fires are usually much less spectacular. Surface fires burn along the forest floor, consuming leaves and brush, or through grass. Surface fires may not consume much timber, but can, nevertheless, kill or damage trees by scorching the bark. Fires may also burn deep in the ground, in peat or decaying forest vegetation; this type of fire is insidious, for it may burn underground for weeks or months before bursting out at some point above ground. A large forest fire, at any stage, may be one or all of these types.

A network of steel lookout towers is the basis of the fire detection organization.

Fire devastation in Nipigon Township. It will be many years before this land yields commercial products.

The fire edge spreading, White River District, 1954.

In addition to the more tangible losses, indirect losses can occur. Wildlife or its habitat may be destroyed. Large numbers of fish may be killed by ashes washed into streams or lakes. Vegetation and humus can be burned, permitting mineral soil to erode away. Forest seed trees and seedlings may be destroyed leaving nothing to replace the forest for many, many years.

Large forest fires in the past have interfered with traffic and commerce. Communications have been interrupted, and motor and rail traffic delayed or diverted. Tourist resort areas suffer from the loss of trade and destruction of scenic values.

Many of these losses cannot be easily calcu-

lated in dollars and cents. It is known, however, that each year forest fire losses run into many millions of dollars. In addition to the losses are the costs of fire prevention and suppression. In Ontario each year some six million dollars are spent in forest fire control work.

How Forest Fires Are Caused

Carelessness or ignorance on the part of some human being is responsible for eight out of ten fires that occur in Ontario. These fires, since they are caused by man, are, at least in theory, preventable. The remaining two fires are caused by lightning, and as yet are not preventable.

Each year in Ontario we expect 1,400 fires will occur, burning thousands of acres of forest lands. Although the area burned is being steadily reduced by improved fire control techniques, we are barely holding our own with the number of fire occurrences.

Careful records are maintained to show how fires are caused. This information is analysed to help direct corrective preventive action.

During the past decade, man-caused forest fires in Ontario have been recorded as follows:

Settlers	9.8%	Smokers	24.4%
Logging Operations	3.0%	Incendiary	2.2%
Campers	29.5%	Prospectors	0.3%
Railways	13.3%	Miscellaneous	12.0%
Road Construction	3.7%	Unknown	1.3%
Mining Operations	0.5%		

Perhaps the most serious single cause of forest fires is the careless smoker — usually unaware of how lethal his cigarette may be and so accustomed to throwing his butt on the city pavement; turned loose in forested areas, he becomes our number one menace. Closely allied with the careless smoker is the careless camper. A single spark buried deep in the seemingly quiet ashes of his camp fire may fan into life or may burn along roots under the surface and spread into the surrounding woods. With the increasing popularity of camping and outdoor recreation, the hazard of fire from these causes is much greater now than in the past. Educational efforts to induce campers to use more care with fire, and prosecution of negligent persons, are helping to reduce these fires.

Settlers or farmers clearing land, burning debris, or clearing a field of old hay or weeds, can be the cause of a serious fire. Progress is being made in reducing these fires through improved farm management and the extension of fire control in agricultural areas. Many fires classed as miscellaneous are caused each year by small children playing with matches or fireworks in wooded areas.

Railroad, logging and mining operations are also a serious threat. These agencies are striving each year to prevent or reduce the number of fires caused by their operations.

Fire Has Beneficial Uses

The old adage "A good servant, a bad master" is a saying true of fire in the forest. Fire in the forest can be beneficial as well as harmful. Foresters are widely accepting fire as a "tool" in forest management.

In the virgin forest, fire was nature's way of cleaning up diseased, damaged, over-mature and dying stands of timber. Fire prepared the way for a new crop of timber. Man, to some extent, has interfered with this process.

Today, on small tracts, foresters are preparing seed beds with fire to encourage natural regeneration. They are also using fire to prepare areas in advance of tree planting. This use of fire is called "prescribed burning". Much research remains to be done, but it is evident that with proper control and safeguards fire can be a valuable "tool" for the forester.

Scouts making sure that their camp fire is completely extinguished.

Administration

The Ontario Department of Lands and Forests is that part of government concerned with all aspects of the management of our forest resources. Headed by a Minister of the Crown and a Deputy Minister, the Department is organized into ten Branches; one of these, the Forest Protection Branch, is charged with the responsibility of protecting Ontario's forests.

The Branch, headed by a Chief and an Assistant Chief, is organized into two sections under supervisors. The Air Service is one section which operates a fleet of aircraft primarily for fire control use as well as for other work of the Department and government. The Forest Protection Section directs the control of forest fires and insect and disease investigation in the province.

That portion of Ontario under organized fire protection covers an area of 130 million acres, containing the presently accessible and potentially exploitable forest. The remaining portion of the province is made up of the agricultural lands and semi-forested areas of stunted tree growth surrounding Hudson and James Bays. These areas are not ignored from the standpoint of fire protection, for in the southern part of the province are county and municipal forests, conservation and watershed authorities, forest nurseries, woodlots and Provincial Parks that must be guarded. In the north are isolated settlements and stands of merchantable timber that require protection.

To carry out these functions over vast areas requires a system of decentralized control. For this reason, the province is divided into 22 Forest Districts each headed by a District Forester who is responsible for forest protection, as well as all other activities of the Department in his district. Twenty of these districts are designated "Fire Districts"; two, in the southern agricultural area, are excluded from the system of organized forest protection except for certain forested areas under management by the Department.

The districts are grouped into seven regions each headed by a Regional Forester who coordinates the activities in two or more districts. Each district is responsible for its protection organization which is directed by a Forest Protection Supervisor under the District Forester. Each district is divided into Chief Ranger Divisions totalling 52 throughout the province. The Chief Forest Ranger is responsible to the Forest Protection Supervisor for fire protection within his area. Chief Ranger Divisions consist of two to three sub-divisions. In charge of each is a Deputy Chief Ranger who is directly responsible to the Chief Ranger. The Deputy Chief Ranger, assisted by Forest Rangers, equipment operators and tower observers, is the man on the "firing line" who actually directs the fire fighting operation.

How Forest Fires Are Controlled

The work of protecting Ontario's forested areas from the ravages of fire falls into three main phases of activity: prevention, preparedness and suppression. Preparedness includes planning, fire detection, communications and transportation.

Prevention

A Forest Ranger will say "the best way to stop a fire is to never let it start." Preventing fires from starting is one of the chief concerns of the Forest Protection Branch. To prevent fire requires a concerned and interested public. Forest protection agencies cannot succeed without the co-operation and support of every citizen.

Sustained educational programmes aimed at making the public more conscious of fire-prevention, have been carried on for many years with marked success. Television, radio and press coverage has made people more aware of forest fire damage. Foresters and rangers work closely with children through lectures, films, slides and poster contests in the schools, and, as a result, children are becoming our most fire-conscious citizens. "Smokey", the "fire preventing" bear, so familiar to children, has become in a short time a North American symbol in the cause of forest fire prevention.

The legislative basis for fire prevention in the province is the Forest Fires Prevention Act. By this Act the period of the year between April 1st and October 31st is declared the "fire season". During this period, certain measures designed to promote fire prevention are in effect. Notable among these is the necessity of

obtaining a "fire permit" from a forest officer before setting a fire for any purpose other than cooking or warmth, and of obtaining a forest travel permit before entering certain well-defined "travel permit areas". There is also provision for closing all or any of the fire districts to public travel should the fire hazard warrant such a step being taken. Persons desiring to carry on operations in forested areas are required to obtain a work permit. This permit may be suspended or cancelled should the fire danger render the operation too hazardous. These and several other measures are included in the Act to help guide the conduct of persons in the woods. Penalties are also provided as a deterrent to those who would commit infractions.

Much progress in fire prevention has been made. In spite of a great increase in forest use, forest travel, and the outdoors by the public, the number of fire occurrences has not increased. But much remains to be done.

Preparedness

This phase of protection is the business of getting ready to control forest fires and involves careful planning. A fire control organization must be established and maintained to high standards of efficiency. Adequate equip-

At top:—A discussion of fire fighting plans during the Goulais Lake fire, Sault Ste. Marie District.

Above:—Radio operator H. E. Bickmore in the main station of the radio communications network at Maple.

Left:—High up in the lookout tower the towerman keeps a constant vigil so that warning wisps of smoke can be detected immediately.

An Otter aircraft at the White River Air Base takes on food supplies for delivery to the fire area.

ment must be provided and maintained in good order; a well-trained staff must be recruited. Plans for adequate fire detection, communication, as well as the other phases of fire control, must be made. Such fire control plans have been developed and put into effect for each fire district based on the conditions and needs of the area.

Over 200 fire weather stations are maintained throughout the province to measure the weather factors that influence burning conditions. These measurements, along with special weather forecasts of the federal Meteorological Services, provide daily ratings on the fire danger in each section of Ontario. These reports are used as a guide to determine the state of preparedness necessary for the fire control organization. If the danger is high or extreme, extra forces are put on standby, special precautions are put into effect, and the whole organization is placed in a state of readiness. The ratings also serve as a basis to restrict the use of fire and are used to warn the public of danger.

The ability to detect and locate a forest fire in its early stages is of the greatest importance. To provide adequate fire detection over an area the size of Ontario requires an extensive network of fire towers supplemented by aerial patrols. There are over 300 steel towers, 80 feet or 100 feet in height, each manned during hazardous periods, and linked to the various Chief Ranger headquarters by radio or telephone.

Aerial coverage is provided by the Department's 45 aircraft operating from 27 bases located across the province. During high danger

periods, or times of low visibility from towers due to haze or smoke conditions, aerial patrols are carried out. Special patrols cover high risk areas or follow up on the path of lightning storms. These aerial detection flights follow a planned route carrying a small crew of fire fighters and their equipment so that immediate action can be taken if a fire is discovered.

Once a "smoke" is detected by a tower observer, he takes a sighting, records the bearing from his tower, estimates the distance and immediately advises headquarters. If more than one tower can make a sighting, an intersection can be made, and the fire location accurately plotted. At the headquarters, the ranger in charge will dispatch a crew of men and equipment by the fastest means possible to take initial action on the fire.

In the more populated areas, local residents render considerable aid in reporting fires. Much assistance is also given by commercial airlines in reporting fires.

During recent years, the success in detecting and reporting fires by the various means has been as follows: rangers 10 per cent, air patrol 20 per cent, fire towers 30 per cent, the general public 40 per cent

A forest protection organization as widespread as that in Ontario requires a modern, reliable system of communications to reach every section of the province because, when a fire is discovered, the information must be relayed as rapidly as possible. In Ontario, each district and ranger headquarters is linked in a province-wide network of ground stations, thus providing the largest radio communications network of its kind in the world.

Two systems are in use: a high frequency network to communicate over long distances between district headquarters and Toronto, and a very high frequency system which is employed within each administrative district for communications with ranger stations, fire towers, aircraft, mobile radios in vehicles and boats, and portable radios on the fire line. The main station of the network is located at Maple, twenty miles north of Toronto, and is linked by teletype to the offices of the Forest Protection Branch in Toronto.

Although the main use of the system is for

Fire fighters pack equipment at the Goulais Lake fire.

fire control purposes, it is also used in the routine administration of all Department of Lands and Forests activities. Altogether, there are now over 1,100 radio telephone units in use by the Department.

In early times of forest protection work in Ontario, rangers constructed their own telephone lines; although most of this system has been absorbed into commercial systems, some 1,500 miles of these lines still exist.

Once a fire is detected and reported to the nearest ranger, speed is the essence in reaching the fire. Fire fighting tools and equipment, and the many other supplies that are required, must be stored in readiness. Trained fire fighters must be available or on standby ready to move with their equipment to a fire in a matter of minutes.

To reach a fire a variety of transportation equipment may be required. A fire crew can often be conveyed directly to the fire by truck; more often it requires a combination of transport, such as truck, aeroplane, boat or canoe. A lot of foot work is also necessary. It is not uncommon for fire fighters to trek several miles from the nearest lake or road through dense bush and rugged terrain to reach a fire.

To provide this system of transportation, the Department maintains a fleet of 900 vehicles, some 45 aeroplanes, over 1,000 boats and canoes, 800 outboard motors, several railway motor cars, and 5 helicopters under lease. Other privately owned or commercial equipment is employed in emergencies.

A great deal of fire fighting equipment and supplies is located in each fire district throughout the province. Regional equipment caches are also centrally maintained so that additional equipment can readily be sent to areas of high fire danger.

For fire fighting purposes, 9,000 hand fire pumps, 1,300 portable power pumps, and 4,000,000 feet of fire hose are maintained in addition to bulldozers, tractors, and thousands of hand tools. The Department also has 2,500 tents and 30,000 blankets in addition to cookery and other camping equipment to supply several thousand fire fighters.

Suppression

A good motto for a "fire boss" is "Hit it hard and hit it fast." Reaching the fire in the shortest possible time is most important. Once at the scene, controlling the fire requires skill, manpower, and equipment. Based on the size, fuel, and weather conditions, sufficient resources must be provided. Most fires are handled by small crews of 3 to 5 men, but larger fires may require crews of up to several hundred men with a vast array of equipment. Such fires present a major problem in logistics — as many as 200 or 300 men may have to be recruited, equipped and placed on the fire line in a matter of a few hours. Food must be provided and prepared, camps must be set up, and a multitude of equipment supplied to maintain a large force of men on the fire. These men must be directed by the fire boss and his assistants, tactics planned, and the fire controlled in the shortest time possible. Fires in the early stages are fought "around the clock" as they are usually more easily controlled at night when the wind is down and the humidity higher.

Each district is organized to handle a normal fire load. Under extreme conditions or heavy fire loads, men and equipment are transported from adjoining districts to assist. At all times, flexibility of the entire Department organization is maintained in order to speed the transfer of

All equipment must be checked, and ready for immediate service.

aircraft, trained and experienced personnel, and equipment to any part of the province where a fire emergency may occur.

Some 600 persons are engaged the year round in fire control work. This staff is augmented by a seasonal force of 2,000 men during the fire season. Extra help is engaged during emergencies, and under the Forest Fires Prevention Act, authority is granted to recruit any able-bodied men between 18 and 60 years, provided they are not engaged in other essential duties.

Suppressing a forest fire is a complex business requiring skill, long hours, and hard work; trained men are needed and the entire force must be effectively employed. The numerous lakes and streams in Ontario's forests enable power pumps and hose lines to supply water as the chief means of controlling fire. Back-pack water pumps, shovels, axes and axe-hoe pulaskis are the most frequently used tools. Where conditions permit, bulldozers or heavy fire ploughs are used to cut fire-breaks down to mineral soil. Where fire areas are accessible to roads, tank pumpers mounted on trucks are used; various track-type vehicles are also employed to carry men or supplies to the fire line.

The method of attack varies with the fire conditions. As no two fires are alike, each fire presents a different challenge to the fire boss. The fire boss employs general principles, however, in organizing his crews and attacking the fire; he must cool the fire with water, smother it with dirt or remove the fuel. A fire line must be established around the fire, extinguishing the most dangerous sections first, then smothering the fire edge with the various tool employed. At times, it may be necessary to fight fire with fire. This requires trained men who, from some established line, road, or stream, may back-fire or burn-out the intervening fuel, thus slowing down the fire spread. Portable radios are used to communicate with and direct the activities of the scattered crews along the fire line. Aircraft and helicopters are also used to scout fire control progress.

Once under control, the fire crews can be released, equipment gathered, repaired and made ready to go again. A crew of men are left to mop up and patrol the fire until they are certain it is extinguished.

Through the smoke-filled forest men must look for the fire itself.

Fire fighters hose water on the last embers near Peshu Lake, Mississagi, June 2nd, 1948.

After the fire, equipment must be returned to base to be made ready for the next alarm.

In a burned-out area a weary fire fighter rests for a few minutes.

New Advances in Forest Fire Fighting

Great strides have been made in fire fighting methods and equipment since the early days of forest protection in Ontario. Men of the Department of Lands and Forests have been responsible for many of the new ideas and developments. The Department pioneered in the use of aircraft for forestry purposes. The world famous Beaver and Otter aircraft were designed and developed to meet the requirements of the Ontario Department of Lands and Forests and other agencies with similar needs, placing special emphasis on forest fire control work.

Helicopters have been used in Ontario since 1946 for fire control work. With their special

features they have proved an invaluable tool. They have been used for dropping chemical retardants and water on fires, for scouting and mapping, and putting men and equipment into inaccessible areas to extinguish lightning-caused fires.

The Forest Protection Branch has pioneered in the technique of applying water on fires from aircraft. Using nearby lakes, the Department's Beaver and Otter aircraft can pick up and discharge from 80 to 160 gallons of water in a single drop. Small fires can be drenched by repeated drops. This technique has proved most effective in helping to control smaller fires in the early stages or holding down "hot spots" on larger fires until ground crews can reach and extinguish them.

The organization and training of fire fighters has been highly developed. Special teams of trained fire fighters have been selected and organized for initial attack on fires. These crews are called "shock forces" and are the commandos of fire control work. The use of "smoke chaser" crews carried in patrolling aircraft to attack fires as soon as spotted, has been an effective development.

Dropping of supplies and equipment by parachute in special containers to fire crews on the ground has speeded up the movement of equipment and the attack on fires in inaccessible areas. This permits fire fighters to move in quickly on the ground from the nearest lake or road, and reduces the labour in packing equipment or supplies.

Mechanical track-type vehicles are being used to transport men and equipment over streams, muskeg, and through bush to difficultly accessible fires. Slip-on water tanks and pumps that can be readily mounted on trucks or track vehicles are being used more extensively as new roads make the forested areas of the province more accessible.

In the northern areas of the province, where normal detection facilities are limited, radar stations are tracking and plotting lightning storms. The paths of these storms are then followed by patrolling aircraft to spot possible fire occurrences.

Chemical fire retardants and wetting agents are being investigated and used to some extent. The ready availability of water in most sections of Ontario has not necessitated too extensive a use of these materials.

Special radio transmitters, to be dropped by parachute from the air at the location of small lightning fires, are being developed by the Branch's radio section. The special transmitter then emits a signal to direct ground crews equipped with a portable radio and direction finder to the fire.

Efforts to induce precipitation are being made and some success has been achieved by "cloud seeding". It may someday be possible even to dissipate storms and control or prevent lightning itself, and the fires it causes.

Technical studies in fire behaviour and fire weather are being carried out in co-operation with the Forestry Branch of the federal Department of Northern Affairs and National Resources. Information from these studies will play its part in improved fire control.

Insects and Diseases

Almost everyone has observed during trips to the woods that there is a close association between trees and insects, and, indeed, it can be considered that forest insects and diseases

Portable radio transmitters increase the speed and effectiveness of fire fighting.

Left:—A helicopter hovers over a fire during a training course at Jellicoe. The helicopter's unique capabilities make it especially valuable in forest fire control work.

Below:—One of the newer methods of fire fighting — water-dropping from float-equipped aircraft. New equipment for water-dropping installed on Otter and Beaver aircraft has greatly increased the effectiveness of controlling forest fires from the air.

Above:—Fire boss Herb McWatch leaves a helicopter after a flight around the fire at North Davis Lake, White River District.

Right:—Parachutes are used to drop supplies to fire crews on the ground. Twin parachutes were used to drop this canister containing a pump.

The effect of severe blister rust on white pine.

is generally more vital, than if the tree were in a natural stand where investment may be quite low and stocking more than adequate.

Statistics of actual losses in wood volume brought about by destructive insects and diseases are not obtainable. For Canada as a whole, the average annual loss is conservatively estimated to be almost five times the losses from fire. In Ontario the tremendous volume losses caused by the spruce budworm alone over the past two or three decades have far exceeded

The damage caused by the spruce bud major inse

that are native to Ontario are as much a part of the forest as are the trees themselves. There are many species of insects which feed on trees, and, consequently, a great potential for destruction exists at all times. However, this usually becomes serious only when, among other things, species of trees which provide the best food become over abundant. Although it is theoretically possible to control most insect problems by regulating the tree population, this is often impractical and it is then necessary to resort to the other forms of control, namely, development of parasites and diseases to kill the insect pests, or spraying with chemicals.

The economic status of insects and diseases, or the extent to which control action is warranted, is often difficult to determine because it is related to time and place; that is, whether the wood resources are plentiful or scarce, whether in plantations or natural stands, and location in relation to markets. The loss of an individual tree by insects or disease represents a greater immediate economic loss when the tree is in a plantation where a considerable investment has been made, and where stocking

losses by fire. In fact, the extremely inflammable condition of the forest resulting from the dead spruce and balsam trees after a budworm epidemic, has set the stage for most of our serious fires. This emphasizes one of the more serious aspects of a widespread insect epidemic. The spruce budworm causes more economic destruction to the forests of Ontario

than all other insects combined. Similarly, the white pine blister rust, an accidentally introduced disease of Asiatic origin, is our most important disease organism causing tree mortality, since it causes, if left unchecked, considerable mortality in our valuable but limited white pine resources. The Dutch elm disease is another imported disease, and while it is not likely to have any impact on the lumber industry, it will undoubtedly destroy large numbers of elms used for ornamental and shade

bud major insect threat to Ontario's forests.

purposes, and will thereby change the appearance of the landscape in southern Ontario.

As stated at the beginning of the article, the need for reducing the damage caused by harmful insects and diseases is becoming more pressing. This is because the woods industry has expanded to the point where we have a distinct shortage of certain species, such as white pine, and are approaching the maximum allowable utilization of spruce. This means that for these species especially, we cannot afford to lose trees through insects or diseases. Since every stage in the life of a tree from seed to tree maturity is subject to insect and disease problems, the need for protection is continuous among trees of all ages.

Joint Programme

The programme dealing with forest insect and disease problems in Ontario is shared co-operatively by the Department of Lands and Forests and the federal Department of Agriculture. This co-operative programme is unique in Canada in that the working facilities were provided by the province, the staff of researchers and equipment were provided by the federal government, and the work programme is under the annual review of a joint federal-provincial advisory committee. The federal Department of Agriculture is responsible for conducting comprehensive surveys annually in order to keep insect and disease conditions under close surveillance and for a programme of research to provide a sound basis for recommending methods of control. The Department of Lands

Dutch elm disease may change the familiar landscape of the heavily settled parts of Ontario.

and Forests, for its part, assumes the responsibility for formulating and carrying out the control policies and programmes.

The work of the federal government in forest insects in Ontario is centred at Sault Ste. Marie, where a research laboratory was built by the province in 1945. At this centre, research is in progress on all the major species of insects, as well as detailed studies on host trees. The province-wide survey of the occurrence of forest insects is also based at Sault Ste. Marie and this survey provides the basis for mapping infestations, assessing damage, and noting the distribution of destructive and beneficial insect species throughout the province.

In 1952, the province built a laboratory at the Department of Lands and Forests' Southern Research Station, at Maple, for studying forest tree diseases. Here the federal government conducts research on tree diseases in forest nurseries, plantations, and natural stands. The tree disease survey, which is carried on co-operatively with the forest insect survey, is also an important phase of the programme.

A healthy elm provides pleasant shade along an Ontario road.

Control Programme

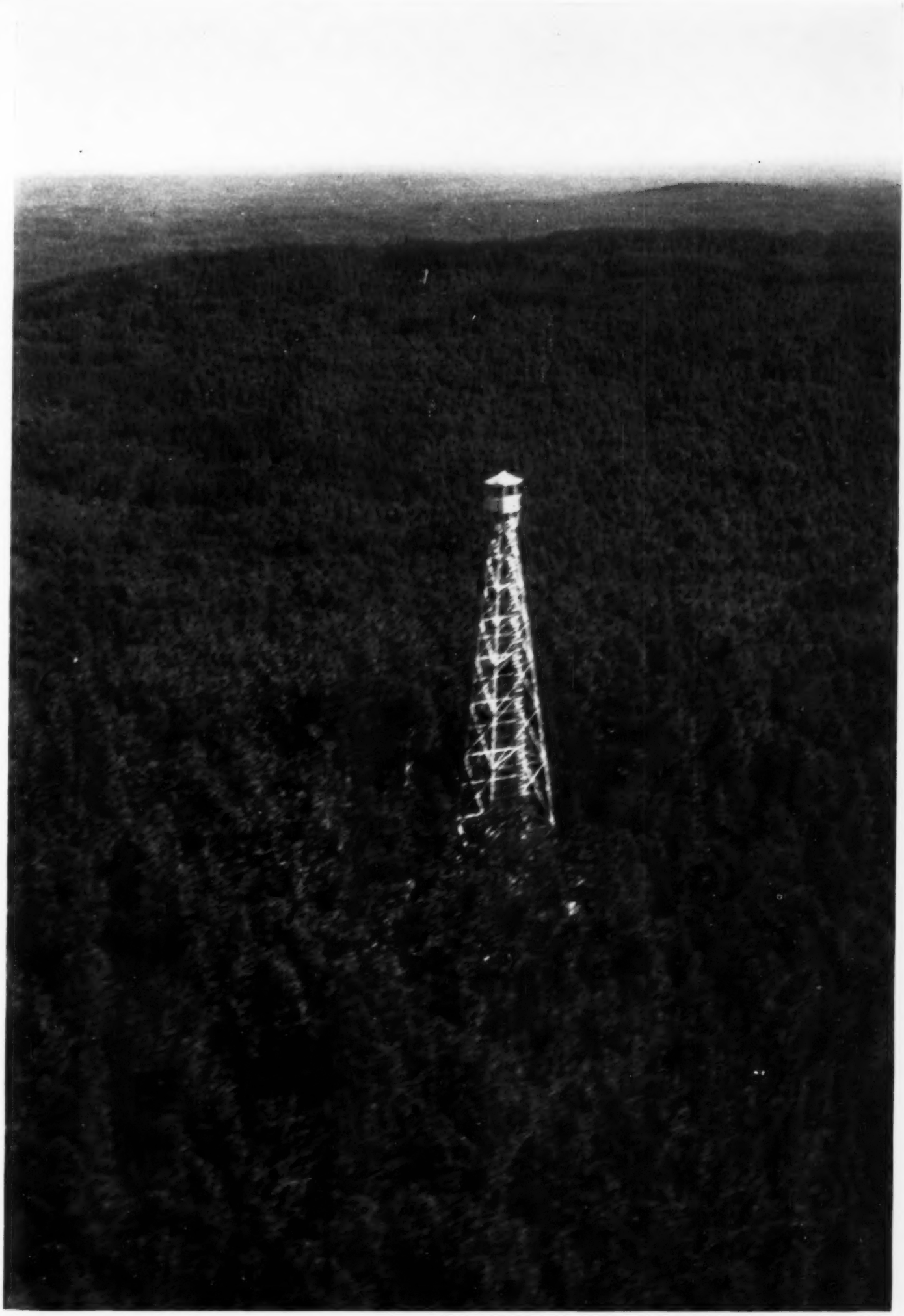
Apart from the attempts to control spruce budworm outbreaks by spraying in the north in the mid-1940s, the province, in recent years, has concentrated its direct control work of forest insect and disease outbreaks in the southern portion of Ontario. The major insect pests receiving chemical control measures are the white pine weevil, various species of pine sawflies, elm bark beetles (carriers of the Dutch elm disease), and the European pine shoot moth. Outbreaks of the European pine sawfly are being effectively controlled by spraying with a virus disease of this insect. The research programme is yielding promise that the use of insect disease organisms to control destructive insects may be more extensive within a few years. This, of course, would be very desirable since chemicals are not selective and therefore tend to kill all animal life with which they come in contact. For this reason the use of chemicals on a broad scale is discouraged as much as possible.

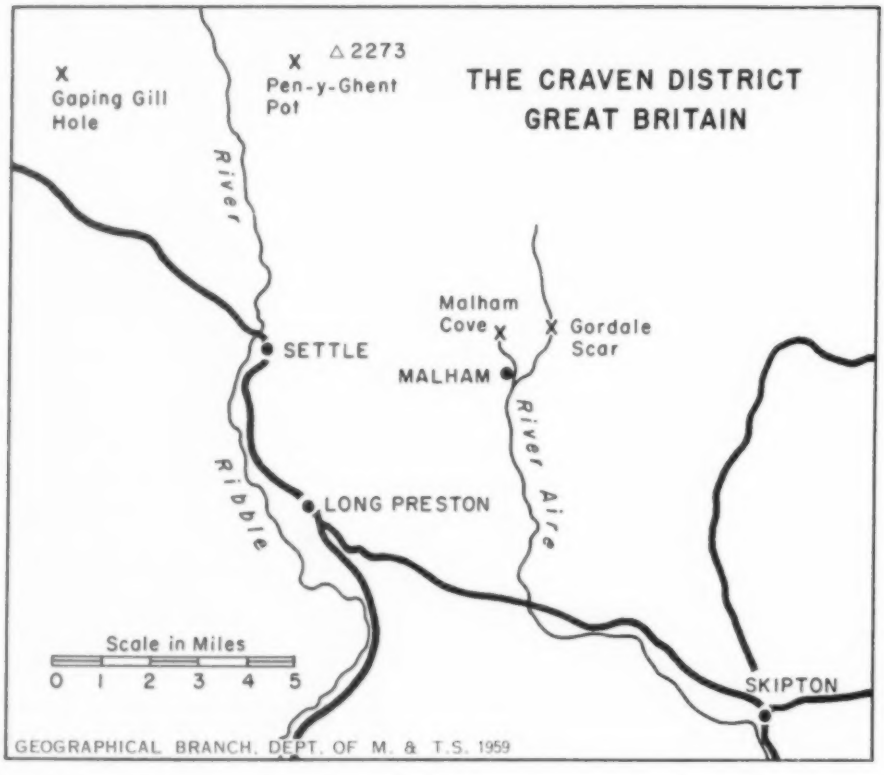
The disease control programme is confined at present largely to the white pine blister rust. This disease can be effectively controlled by eradicating the alternate host, currant and gooseberry plants from the vicinity of the pine trees. This is accomplished through the use of herbicides, and each year several thousand acres are treated in the important pine producing areas of the province.

As new forests develop throughout Ontario, it is likely that insect and disease problems will increase. It is with this in mind that the province has provided a joint research establishment, with the federal government, which should be capable of meeting the needs for several years to come, and the increasing development of our wood resources will generate more intensive control action.

Science and research are playing an ever increasing role in the understanding and control of forest insects and diseases, the knowledge of fire behaviour, and the development of special equipment. But the co-operation of the people of Ontario and visitors who travel in the forests is still, and always will be, a major factor in forest protection in Ontario.

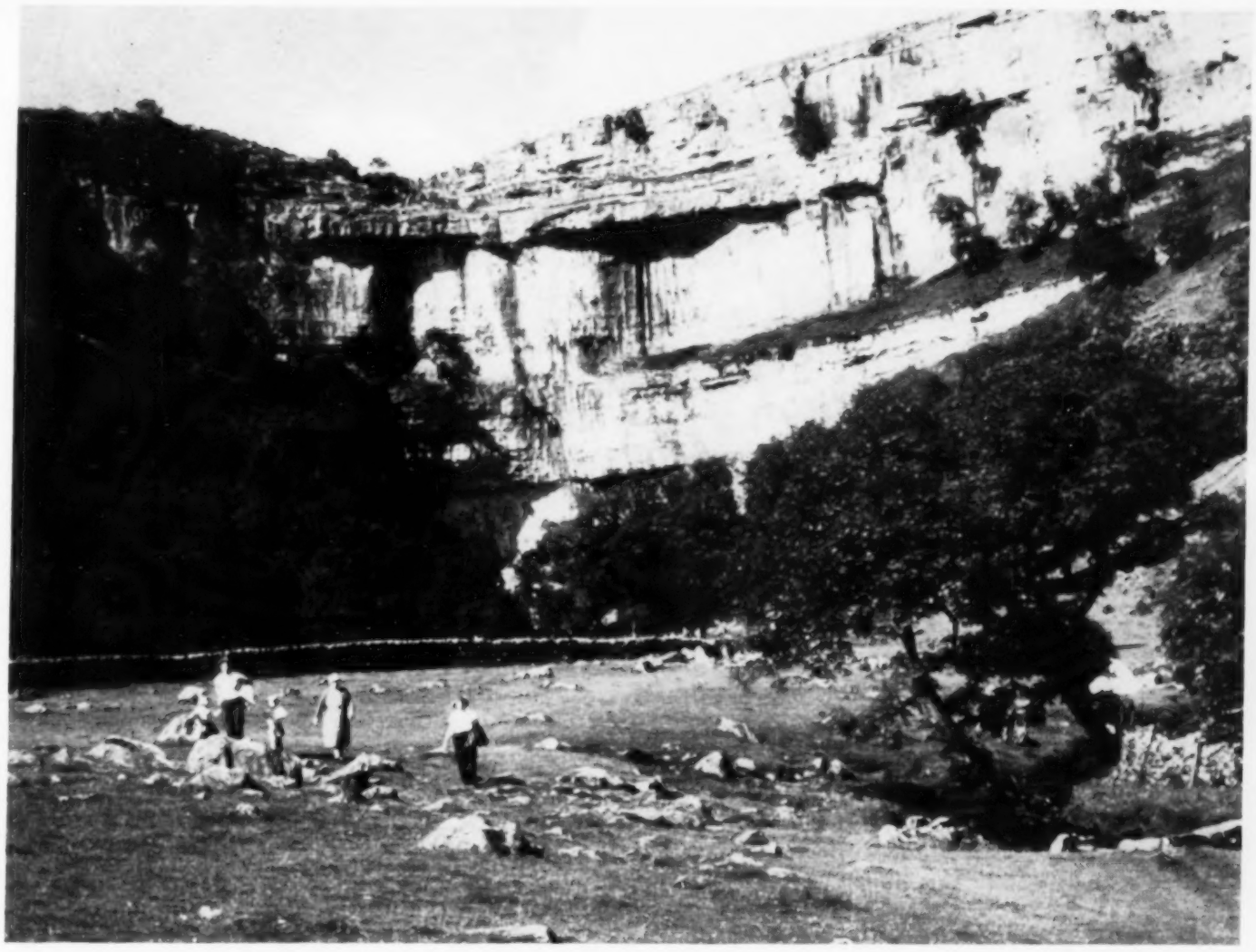
Right:—Protection of the vast forests of Ontario requires constant vigil.





Above: — The limestone scars of Craven give a peculiar light quality to the valleys. Stone walls divide the pastures where sheep graze.

Top right:—The precipitous rock face of Malham Cove, Yorkshire. Near by is the house where Charles Kingsley wrote part of his popular children's story The Water Babies.



The Craven District of Britain

by JAMES S. SHACKLETON

In the moorland of the Pennine Hills is a small area, half the size of Prince Edward Island, which is unique in Britain. It is the Craven District of Yorkshire, distinguished immediately by its dazzling white rock, the Great Scar Limestone, into which is etched some of the finest karst topography in Europe.

The Great Scar Limestone underlies a large part of northern England as a flat sheet about seven hundred feet thick. It is covered in many places by younger rocks, but in Craven it is exposed at the surface. The bright whiteness of this rock gives a peculiar light quality to the valleys and serves to set the area apart from others. Because of it, the boundaries of Craven are quite distinct. Even the stone walls reflect the change from one kind of rock to another over surprisingly short distances.

The dramatic nature of this junction is well displayed from the top of Malham Cove, a 250-foot cliff and one of the spectacles of Craven. At this point the limestone bursts from the bondage of pastoral England and soars loftily above the tidy green fields. One looks down from the top over a pastel-hued carpet of sleepy meadows merging hazily in the distance with the summer-blue sky. Behind, though, is a scene that could well be part of Macedonia or Algeria. Battlements of white limestone cut jagged silhouettes into a clear sky and small

Gordale Scar, a chasm near Malham. The height can be judged from the figure of a man standing on the rock-strewn floor.

The dry-stone walls are a feature of the Pennine country.

patches of grass splash the rocks with emerald green.

A river once flowed over the top of Malham Cove as a gigantic waterfall, and men of many civilizations have gazed upon it. Below the Cove are remains of Iron Age fortifications, and Roman legionaries once marched through the district. And perhaps a Viking invader carried with him a memory of this fall when he ventured across the sea and saw that other limestone cataract, Niagara, beyond the shores of Vinland.

Today, a dry valley leads to the edge of the Cove, and a notch in the limestone is the only reminder of the waterfall. About two hundred years ago the stream found its way underground and now emerges from the base of the Cove after flowing through underground passages in the limestone. It is only one of the many rivers that have made a veritable honeycomb out of the Great Scar Limestone.

The reason for this is to be found in the nature of the rock. During the Carboniferous Period, Great Scar Limestone accumulated in the tropical sea which then covered parts of Britain. The conditions of deposition were somewhat similar to those prevailing today on the Australian Barrier Reef and the Grand Banks of the Bahamas. In the warm sea, corals, crinoids and other lime-secreting organisms grew, and their shelly parts slowly accumulated. The low-lying land supplied very little sand or clay, and so today the Great Scar Limestone consists almost entirely of calcium carbonate. This is insoluble in pure water, but rain-water acidified by atmospheric carbon dioxide is able to carry away appreciable amounts in solution. Thus, cracks and crevices can be widened and deepened. Two other factors, however, are of great importance in the development of underground passages in the Craven District. The first is that the flat limestone sheet is broken by faults and joints spaced in regular sets. These are ready-made channels whereby surface water can seep directly into the body of the limestone. The second point is that the water-table in Craven is low, because the river valleys are deeply entrenched. There is, there-

fore, in the Great Scar Limestone a deep zone of aeration within which surface water is flowing down to the water-table through narrow joints and along bedding planes. It is within this zone that caves and potholes are formed.

Solution, of course, begins at the surface; the broad limestone pavements eventually present a grotesque appearance. Joints are widened and deepened until they reach down for hundreds of feet to become, in the Yorkshire idiom, potholes. The deepest in Craven, and also in Britain, is Pen-y-Ghent Pot, 525 feet deep, discovered in the last few years.

Of all the Craven potholes, however, the one foremost in underground lore is Gaping Ghyll, the first one to be systematically explored and described. Professor E. A. Martel of Paris, swinging down on a rope-ladder for 340 feet, made the first descent in 1895. When he reached the bottom he discovered one of the largest underground chambers in the world, large enough to accommodate any of Britain's cathedrals.

Since those days the sport of potholing has grown in stature. Today, if you walk over any of the limestone-scarred moors, you are likely to find at any hole in the ground a pile of clothes and rucksacks, with the owners nowhere to be seen. They are underground, crawling and swimming along limestone passages and enjoying every minute of it. Many potholers also carry out systematic scientific work, in addition to merely enjoying the sport. At present this is mainly directed toward accurate surveys, water tracing, and the collection of specimens of rocks, fauna, and flora.

Water tracing is usually done by means of the green dye, fluorescein, which shows up in concentrations as low as one in a hundred million under favourable conditions. A few ounces are put in the sink to be tested, and then all neighbouring springs are observed for as long as possible. Any spring which shows up green, of course, must have underground connections with the sink. Work so far has shown that underground drainage is radially outwards in the limestone from the highest ground, but is modified profoundly by faults and joint planes.

Potholes and caves are closely associated, and an underground system usually consists of a series of caves and potholes connected together. The caves develop along horizontal planes in the limestone, bedding planes or junctions between limestone and other rocks. It is in the caves that stalactites and stalagmites, and other limestone growths are to be found. All shapes and sizes occur, and the resemblance of some of them to familiar faces and features is uncanny. Elephants, mountains, famous people, all are represented. But one group of stalactites gives a truly magnificent picture when seen by torchlight reflected in a pool below. One has a perfect impression of an aerial view of the skyscrapers of New York.

Stalactites often have growth rings similar to those of trees, and some are hollow, which stalagmites cannot be. The latter, however, often have cup-like depressions on top of the pedestal in which cave pearls have been found. These are quite rare and seem to be restricted to certain caves or cave-systems. The seed of the pearl is a sand grain around which layers of calcite are deposited.

The grotesquely etched surface of a limestone pavement.

Malham village and the pack-horse bridge; the lower portion was built in the sixteenth century.

Cave systems that are near the surface are subject to roof collapse, with the consequent formation of a gorge. This has happened in numerous places, but none more spectacular than at Gordale Scar, perhaps the finest chasm in Britain. The 400-foot walls glower broodingly down on a fairy waterfall which is almost perpetually in their shadow. Only for an hour or so in the afternoon does the sun reach a position from which it can smile upon the plunging, leaping spray that dashes over the limestone tufa in the floor of the gorge.

It was here that William and Dorothy Wordsworth "rested under the great rock and drank of its cold waters". Thomas Gray found it dreary. But many other literary personalities have derived inspiration from Craven. Wordsworth, of nearby Lakeland, visited the district often, and much of Charles Kingsley's *The Water Babies* was written in the Craven District.

The wild scenery inspired these men, but in addition to this, Craven is noteworthy for sheep rearing. Since the Angles built the first villages, flocks of sheep have grazed on Craven moors. Theirs was the wool which helped to found the Yorkshire woollen industry, and although they have now been surpassed by imports from Australia and elsewhere, sheep shearing and sheep fairs are still an important part of Craven life.

In one important respect, however, the Craven District is still intimately linked with the Yorkshire woollen industry. It is here that the people who live and work in this sprawling, gargantuan mass of industry which flanks the Pennines can briefly escape to feel the clean wind and listen to the haunting cry of the curlew sweeping low over the moors.

Above:—Pastoral England from the top of Malham Cove. The gravel ridges on the right are remains of Iron Age fortifications.

Right:—Potholers rest at the entrance to Gaping Ghyll.

Origin and Evolution of Eskimo Cultures in the Eastern Arctic

by JÖRGEN MELDGAARD

Photographs by the author

THE fascinating problems concerning the origin and evolution of the Eskimo and his culture have attracted a large number of students representing various fields of science. It is an old truth that relationship in race does not imply relationship in either language or culture, any more than the same mode of living necessarily involves a similarity in language and physical character.

A term such as the origin of the Eskimo therefore, is ambiguous and if it is to be used at all we must first be clear as to whether it refers to his purely physical descent, to the development of his language, or to the origin and history of his culture.

In the field of archaeology our problems are primarily concerned with the material culture and here again the student is confronted with the question of what he means by "origin".

A culture is constantly being transformed by development and decay; in a way, it may be considered without a beginning if the culture

The valley of Sermermiut, in West Greenland, where archaeological investigations revealed the deposits of three prehistoric cultures. The main area of excavation is within the circle.

cannot be traced back to its very source at the emergence of mankind. If the problem is to be kept within reasonable bounds, we must define the origin of a culture *not* as the origin of its separate elements, but of their synthesis; and *not* of any synthesis of these elements, but as the formation of that particular complex which distinguishes it from other forms of culture. With regard to Eskimo culture this means its adaptation to the sea.

From archaeological investigations, however, it gradually becomes clear that one can hardly talk about *the* origin of Eskimo culture. There was no single tap-root planted in the Bering Strait area, nor in the central Canadian Arctic. Eskimo culture appears to have grown up like the arctic willow, a bush with root-suckers rising from below the ground. The roots of Eskimo culture emerge from a substratum, ultimately of Asiatic origin, but for the larger part of old American character and of wide distribution in the boreal zone from the Yukon River to Newfoundland.

Consequently the problems cannot be solved in one particular geographical area and archaeologists are frequently changing their field of work between Greenland, Canada, and Alaska. They have realized that co-operation is not only helpful but necessary in solving the questions of origin and evolution. During the two investigations to be described on the following pages the author has profited highly from working together with Canadian and American students in Eskimo culture.

A number of archaeological findings in Greenland formed the background for the author's investigations in the Canadian Arctic. In northernmost Greenland sites on old elevated coastlines represented an early, but undated, Eskimo culture, and scattered stone artifacts indicated that related people also once inhabited large parts of West Greenland. A small collection of these artifacts found *in situ* at the settlement Sarqaq in Disko Bay was then, in 1952, interpreted as the traces of an early form of Eskimo culture with strong affinities to Alaska and, ultimately, to Stone Age cultures in Siberia. This stage has been named the Sarqaq culture, an appropriate name also because Sarqaq means "the sunny side" and the culture seems to have flourished in a period of relatively warm and dry climate.

Excavations carried out the following year in Disko Bay, at the old settlement Sermermiut at Jakobshavn, revealed, under a luxurious layer of grass in the deserted valley, the "Rosetta Stone" of the Eskimo cultures in West Greenland. Our spades cut through the deposits of three prehistoric cultures laid down in clear stratigraphy. The script was interpreted jointly by archaeologists and pollen-analysts.

The traces of Sarqaq-man were disclosed on virgin soil in a depth of seven feet and under

The Sermermiut site in Disko Bay, West Greenland. Icebergs are seen at the mouth of Jakobshavn Icefjord.

layers of peat and artifacts deposited alternately by nature and by man during the last three thousand years. In a higher horizon were the flint blades of the Dorset culture known from Canada, while the well-preserved remains of the whale-hunting Thule culture people turned up in the uppermost layers. The type and contents of the various peat formations indicated that the Sarqaq, as well as the Dorset, people were favoured by periods of rather warm climate of continental character, separated in time by a period of more moist conditions from 600 or 500 B.C. to about the beginning of the first century A.D. In both cultures the hunting of seal and caribou was probably facilitated by warm summers with much open water and by winters with limited snowfall, and both cultures disappeared from Sermermiut before or at the beginning of a period with increased precipitation, which may mean that snow conditions became more difficult; probably neither of them was in possession of dog-pulled sledges.

When the ancestors of the present-day Greenlanders (and of the Canadian Eskimos), the Thule culture people, entered the scene in the thirteenth century, the surroundings had changed once more due to a colder and drier climate, which was to continue until our time, reaching a maximum of deterioration in Disko Bay as late as 1800-50. During the preceding three thousand years the climate had never been less favourable than at that period. The Greenlanders, however, now knew how to fight Nature and to survive by means of their dog sledges and their splendid kayaks. The descendants of the Thule culture in arctic Canada changed their ways from dependence on the big whales to a nomadic life in snow-houses, seeking out the seals on the sea ice or following the herds of caribou inland across the tundra.

A survey of archaeology in the Canadian

Arctic has recently been presented to the readers of this journal by William E. Taylor*, and the following account is therefore confined to the results obtained during two seasons of investigations in the Igloolik area, Northwest Territories. The investigations of 1954 were sponsored by the Danish National Museum, the University of Pennsylvania Museum, and the Arctic Institute of North America. Excavations in the same area in 1957 were supported by the Danish National Museum and the University Museum of Archaeology and Ethnology, Cambridge. In both seasons the work was carried out with extensive assistance from the Department of Northern Affairs and National Resources and the National Museum of Canada.

The Igloolik area turned out to be extremely well suited for a study of the evolution of early Eskimo culture. This flat, harshly weathered limestone country exhibits very marked features derived from the post-glacial marine emergence. Raised gravel beaches are visible in practically all places. The Thule culture sites were found to be situated on raised beaches from 3 or 4 metres to about 8 metres above present sea level, as observed already by Therkel Mathiassen during his pioneering work in 1923 and by Graham Rowley, in 1937 and 1939, during his excavations at the important

*See "Archaeology in the Canadian Arctic," by William E. Taylor, Jr., *Canadian Geographical Journal*, September 1958.

Excavation at the main profile at Sermermiut. The Sarqaq culture was found in the bottom in layer B, the Dorset culture in E, and the Thule culture in H.

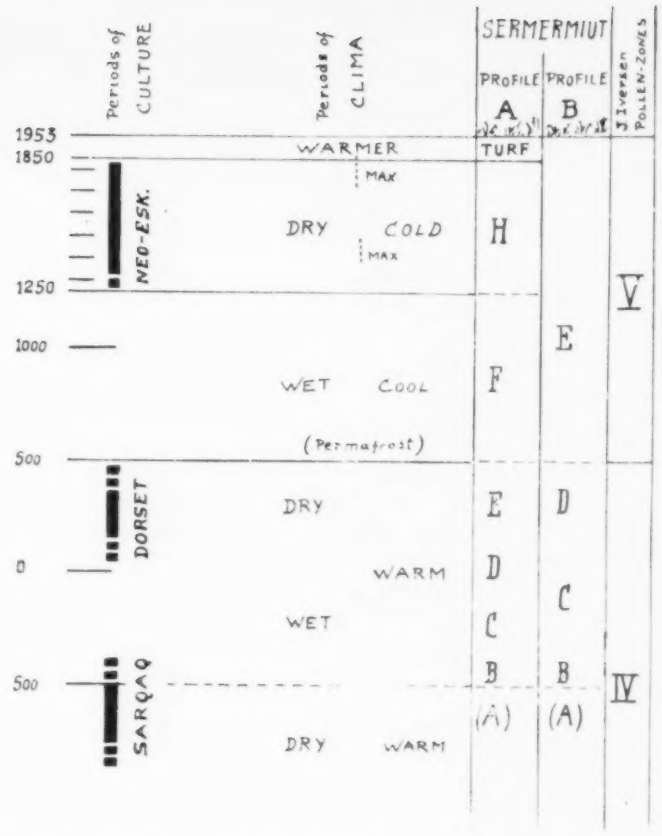
Detail of the lower part of the profile shown on the preceding page. The layers were deposited alternately by nature and by man from 600 B.C. to A.D. 1300.

Dorset site, Abverdjar, situated on levels from 8 to 12 metres above sea level. In 1954 we located eight Dorset sites and four pre-Dorset sites (which shall here be termed Sarqaq sites) on terraces from 8 to 54 metres, all of which with certainty can be placed in the chronological "scheme" formed by the system of elevated beach lines.

The knowledge of houses from the Dorset culture was limited in 1954. In fact only one real house had earlier been attributed to this culture; this was a ruin on Mill Island in Hudson Strait of a form influenced by the Thule culture. Consequently it was a pleasant surprise for us, when arriving in the early spring at the summer camp of the present Igloolik Eskimos, Alarnerk, to find on the terraces 208 rectangular depressions, each of which represented a Dorset house. This very north-east corner of Melville Peninsula is probably the

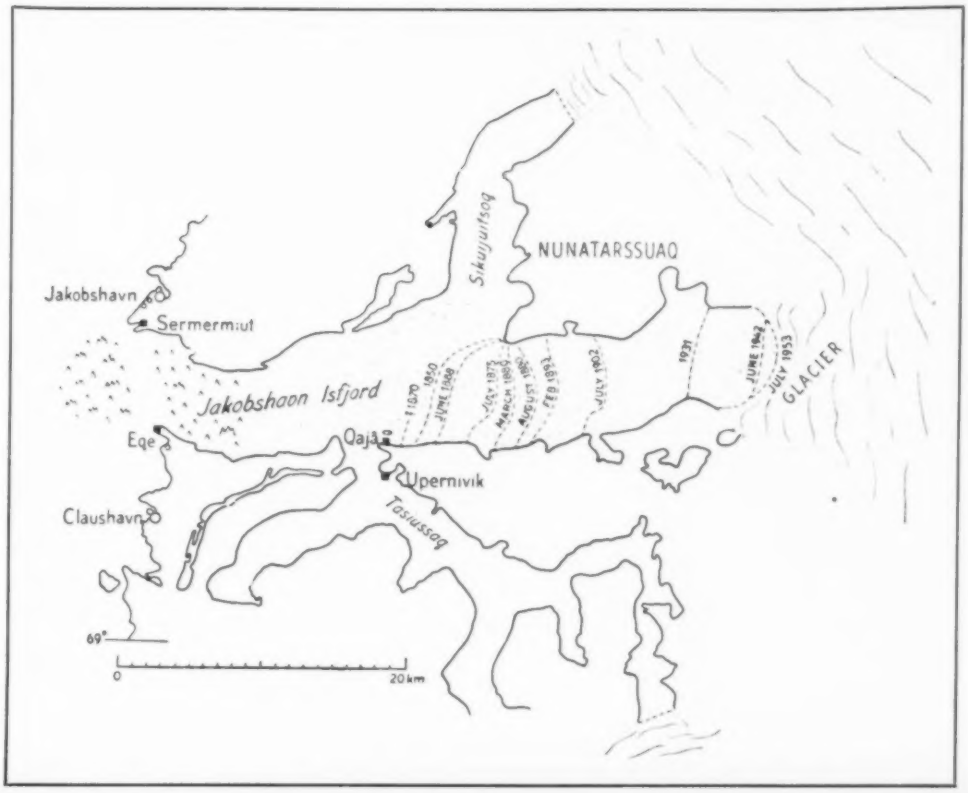
largest archaeological site in arctic Canada. However, these houses were not inhabited at the same time. Their distribution on a large number of raised beaches from 8 to 22 metres above sea level made it possible to divide the site into five arbitrary zones, each intended to represent one stage or period in the gradual development revealed by the types of houses and artifacts excavated. The time-span represented at Alarnerk (from about 700 B.C. to A.D. 1300) seems to include all the Dorset manifestations of which we have knowledge at present. Therefore, being able to characterize each of these five zones statistically and typologically, we are using the terms Period I to Period V.

The Dorset house in the Igloolik area is rectangular from the earliest to the latest period, its size being normally 5 x 4 metres, though a number of very large houses are found quite early, in Period II-III; they measure up to 14 x 7 metres (45 x 23 feet). Small open fireplaces are found on the floor and low benches are indicated along the walls. No entrance passage can be traced, but the house room is dug down to a depth of as much as half a metre below ground level. The character of the walls and the roof cannot be established with certainty, but probably the house was of sod with a skin roof. Only low gravel ridges are now left of the walls, except in the latest periods where stones often line the inner side of the wall.



Periods of culture and climate at Sermermiut.

Not until the last period, where the Thule culture people appear on the stage, are any radical changes in the construction of the house apparent. Probably from these immigrant whale-hunters from Alaska they learned in the thirteenth century to build an underground entrance passage, "the cold trap", a trait frequently seen in the late Dorset houses.

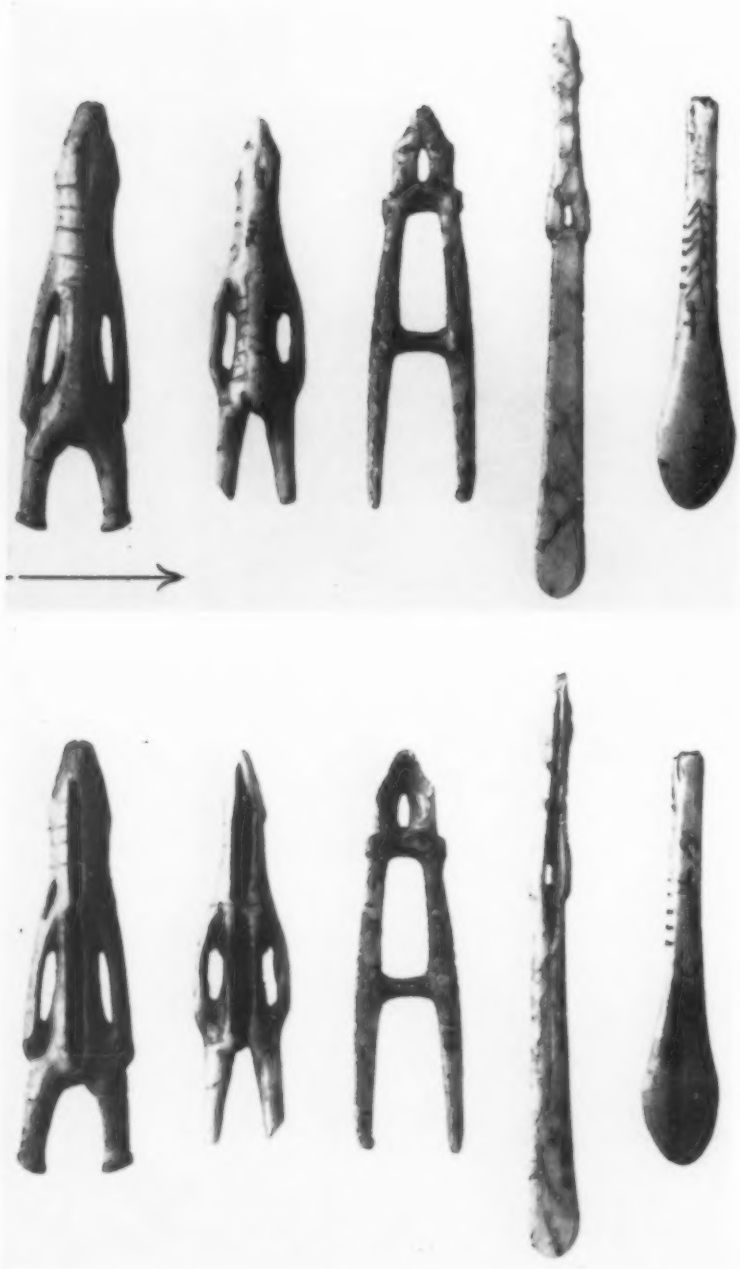


Map of Jakobshavn Icefjord, showing the location of the old sites Sermermiut and Qajâ, and indicating the limits of the glacier from 1850 to 1953. The undisturbed deposits with almost three thousand years of cultural remains found at the Qajâ site, which is situated close to the 1850 limit of the glacier front — the maximum extension of the glacier during this long span of time, are evidence for the theory that the climatic conditions reached a maximum of deterioration only a hundred years ago.

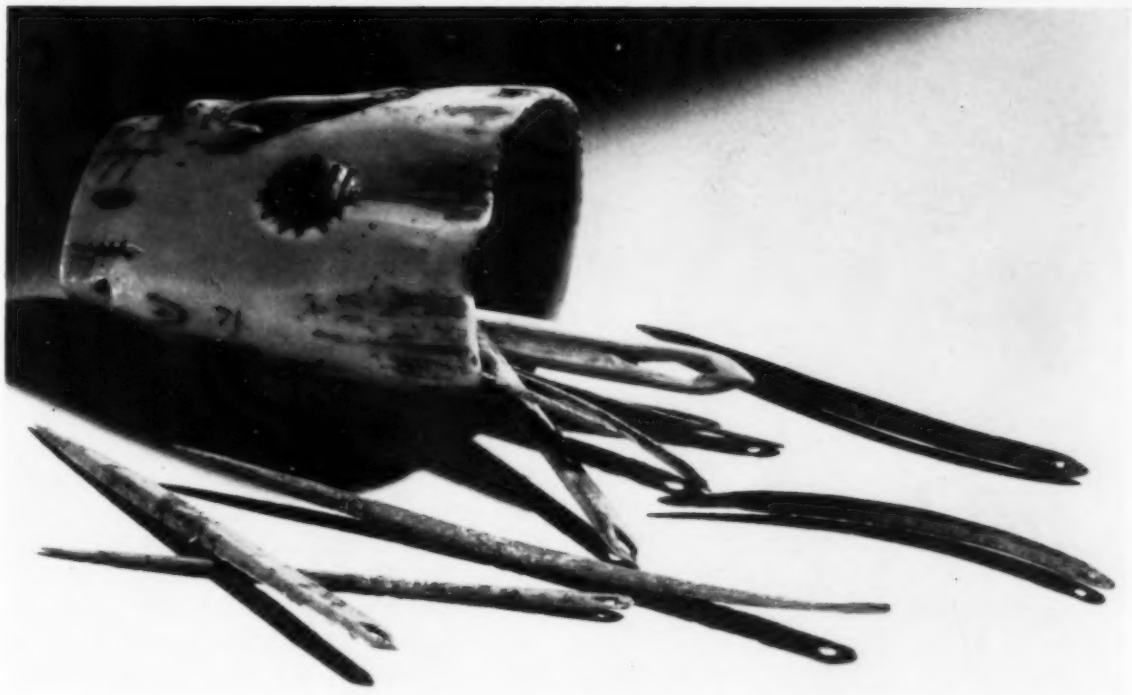
Also the house room is now altered, being smaller and very narrow with small side rooms for the fire-place and for storage, and the practice of constructing one raised sleeping-bench along the rear wall is adopted.

The earliest types of artifacts from the Dorset culture, as found in Alarnerk Period I, were a surprise in themselves. On the basis of the material hitherto known two features, or guide forms, had been emphasized, the presence of which should immediately identify the culture: the characteristic small harpoon heads with rectangular shaft socket and the flint industry with a number of characteristic forms. But instead of these there were, in the houses and middens, some previously unknown forms — large harpoon heads and lance heads with open or partly closed shaft sockets, and blades of ground slate dominating the flint artifacts. Excavations at Southampton Island by Henry B. Collins (1954-5) and on the southern coast of Hudson Strait by William E. Taylor (1957-8) have revealed a material parallel to these artifacts. It is, however, clear that these remains represent the Dorset culture, because the various types that occur on the lower terraces at Igloolik show an unbroken development in which flint gradually supersedes slate and the "typical" artifact-forms emerge. In Period III we meet a type of culture completely adapted to the hunting of sea-mammals, particularly the walrus. An elaborate ice-hunting seems to have developed along these ice-bound coasts, including probably the snow-house later to be taken over by the Thule culture and their descendants, the present-day Central Eskimos. In the final Period V, where Thule culture artifacts are found in the Dorset houses, a change towards a colder climate is indicated (parallel to the deterioration revealed at the Sermermiut excavation at the same latitude in West Greenland). The preservation of a number of pieces of wood may mean that the thaw did not penetrate so far down in the soil, and the various new traits in house construction, including the cold trap, are features which are more than merely chance borrowings from the new fashions which in this period appear with the Thule people.

Like archaeological reports in general, this article is dealing with the rather dry facts of stones and bones, and the theories of evolution. It is, however, possible to present a more complete picture of the Dorset people as the last stage of their prehistoric culture is in part "history", although the last Dorset man lived some six hundred years ago.



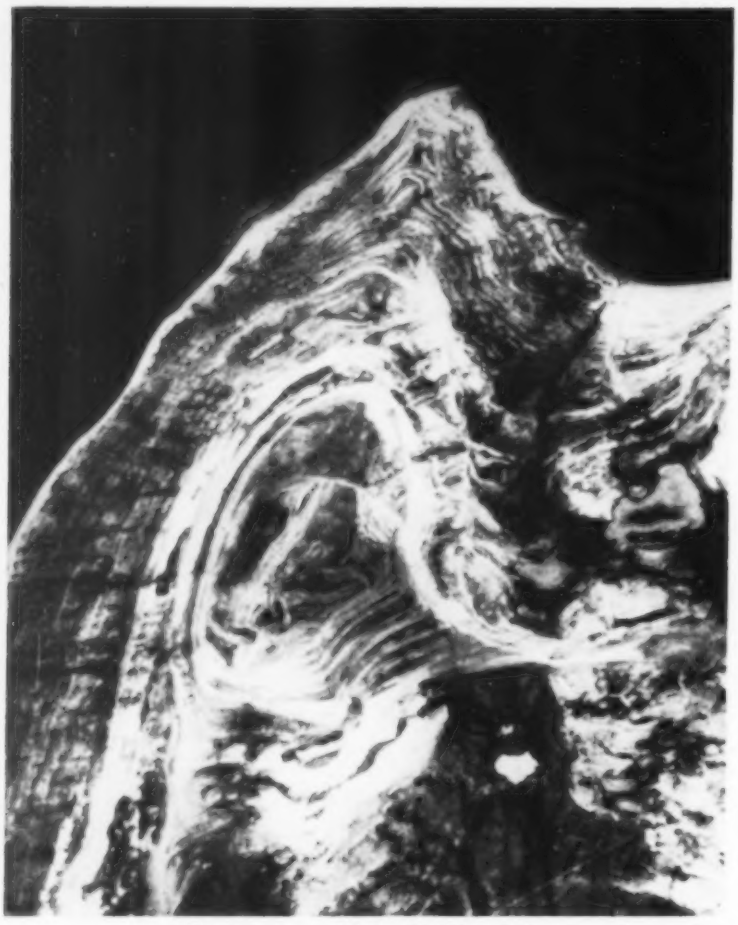
Polar bears carved in ivory during the Dorset culture at Igloolik, Period IV-V (about A.D. 800 to 1300). An example of the typological evolution of the artifacts showing how the naturalistic representation of the animal develops into a spatula-shaped implement, where only the "skeleton design" remains. (Back and underside views are shown.)



Carved ivory needles and needle case from the Dorset culture at Igloolik (circa *A.D. 1000*).

Among the legends of the Central and Eastern Eskimos there is a well-known group of tales which has an historical core; the tales are of the Tunit people, and it was an important additional result of the field work in 1954 to give a new identification of the Tunit. We know of this group of tales from throughout the eastern Eskimo area, including Greenland; and the Tunit, originally often interpreted as Indians, have more lately been considered the people of the Thule culture. But faced in Igloolik with a number of additional illumi-

The manufacturing of micro-blades of flint in the Dorset culture at Igloolik.



Aerial view of Igloolik Island showing the system of raised beaches, where remains of the Sarqaq and Dorset cultures were found (from 2000 B.C. to A.D. 800).

nating stories and description, we realized that the Tunit had nothing to do with the Thule culture — they were the Dorset people.

The Eskimos generally denied, first and foremost, that the Tunit had lived in the large houses of stone and whalebone which belong to the Thule culture; these were the houses of their own forefathers. We were told consistently that the dwellings of the Tunit were rectangular in outline and that the wife sat by an open fire-place within the doorway and prepared the food, and that they lay on a bench which was so short that they had to rest their legs vertically on the wall. Various sites could still be pointed out, where the Tunit had left remains of their buildings and where one could see stone chips from the manufacture of their weapons — and they were Dorset. According to the legends the Tunit were good caribou hunters who could bring down the beasts on foot, armed only with a spear. During the winter they caught seals at the breathing holes in the ice. As the time of waiting could be long the hunter, to keep warm, brought with him a small round stone lamp, which he set before him on a little elevation of snow. By leaning forward he could let the edge of his coat fall over the lamp, thereby forming a sort of tent in which the temperature soon rose and warmed his body. The Tunit often had scars of burning on his stomach, for in his eagerness to harpoon the seal when it eventually appeared, it happened not infrequently that the hunter forgot about the lamp! Another important game animal was the walrus, and here the legendary strength of the Tunit was a great help, not least in the transport back home; for they had no dogs, but only a short sledge which they pulled themselves. The island Uglit, south of Alarnerk, was the last domicile of the Tunit; and often they had to go and catch the walrus far away on the sea ice. Therefore, despite their strength, they were tired when they approached Uglit. However, the women had only to appear outside the houses to bring the strength back to the hunters, for the Tunit were very fond of their women. "Tunit were driven away by our forefathers, sometimes after fights. Our forefathers loved to fight, like the white man," related an old Eskimo named Anangoar.

The people emerging from these tales are in perfect agreement with our archaeological Dorset specimens. But they do appear more alive, and more human, although to the present-day Eskimo they are to be grouped together with the white man as the offspring of a dog . . .

The investigations in 1954 also revealed a still earlier culture, the traces of which were scattered on raised beaches higher than the Dorset levels, up to 54 metres above present sea level. The material found was scarce, the typical assemblage of finely chipped flint blades, but sufficient to identify the people as closely related to the Sarqaq people of West Greenland and to early hunters in Alaska.

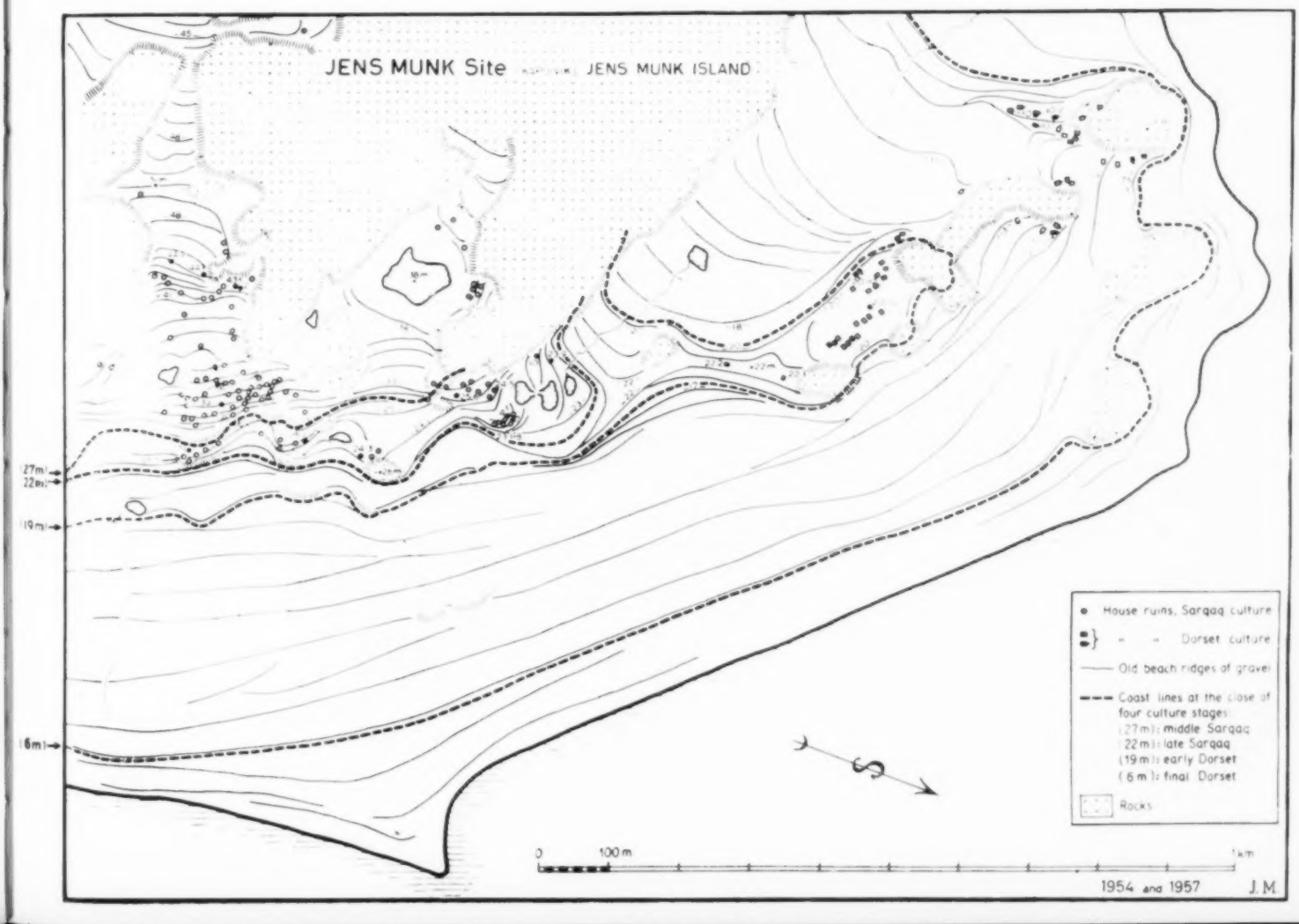
With the purpose of obtaining a clearer picture of this early culture stage and in order to determine its possible contributions to the formation of the Dorset culture, new investigations were carried out in the Igloolik area during the summer of 1957. Several sites with remains from the Sarqaq culture were located,

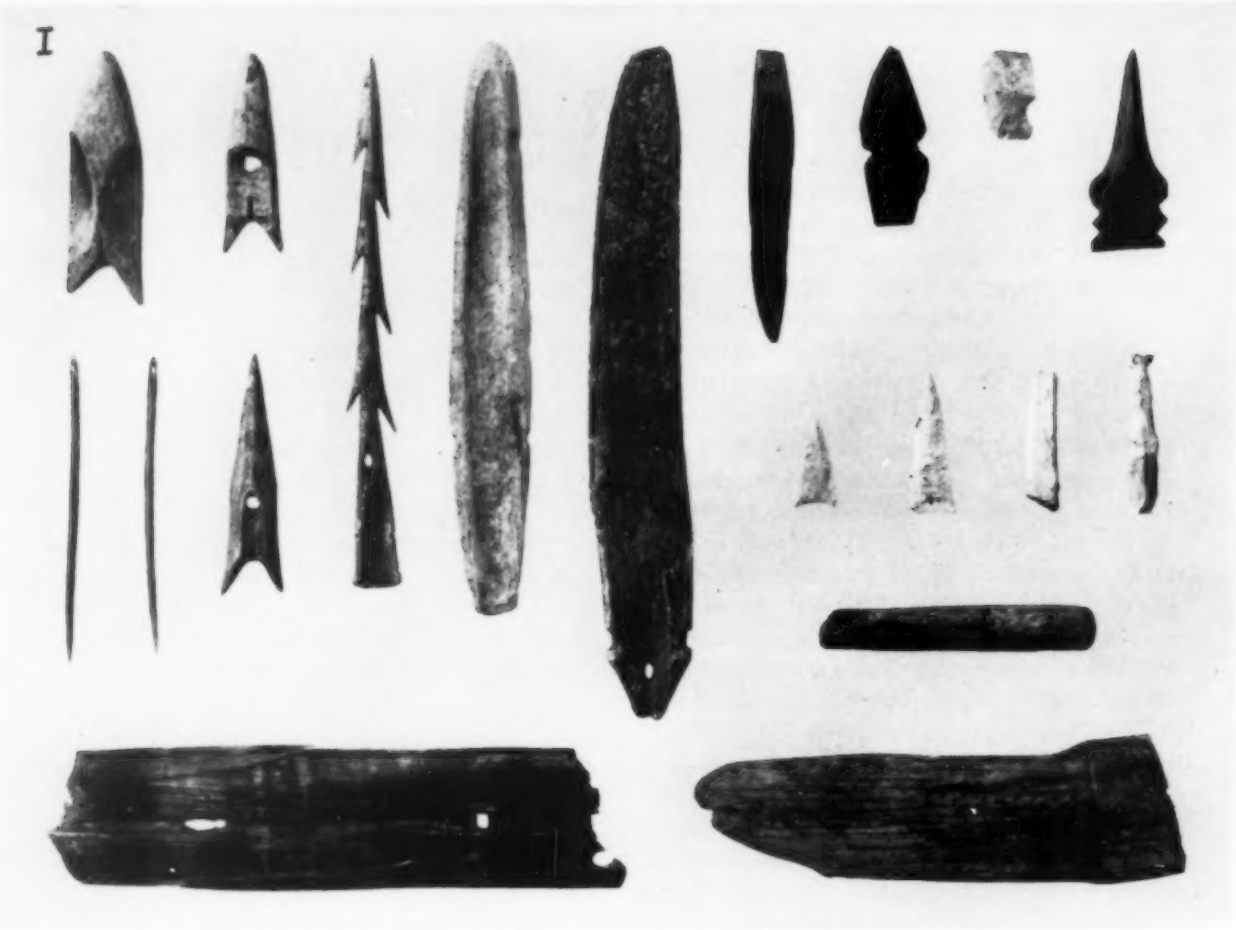
Opposite:—Map of the Jens Munk site on Jens Munk Island, Fury and Hecla Strait. The house ruins from the various periods of the Sarqaq culture and Dorset culture are marked in relation to the elevated beach lines.

but the excavations were concentrated on two large sites: the "Jens Munk Site" on Jens Munk Island and the "Parry Hill Site" on Igloolik Island. The longest and most complete sequence of cultures was found on the Jens Munk site where a large number of dwelling-remains and middens represented the changing populations, from a period when the sea level was about 48 metres above the present level to the camp of the present-day Igloolik Eskimo on the lowermost terraces — a time span of almost four thousand years. Round, or oval, heavy stone rings with a central fire-place dotted the terrace-ridges from 51 metres to 23 metres revealing the Sarqaq habitations; rectangular depressions marked the houses of the Dorset culture from 22 metres to 8 metres, and the massive stone and sod buildings of the whale-hunting Thule people appeared in a period contemporary with the final Dorset stage. Nowhere can evidence of a stationary water plane be observed and apparently there was no period of standstill during the retreat of the sea. The retreat, however, was probably of varying rate; the terraces as well as the radiocarbon 14 dates indicate, for example, a rather fast retreat during the later stages of the Sarqaq period, from about 1500 to 800 B.C.

The dry climate of the Igloolik region has preserved material of bone from the very earliest traces of human occupation, and the archaeologist is therefore in a more fortunate position than in West Greenland or Alaska, where he is ordinarily left with only a handful of stones when excavating contemporary old sites. Bones, and artifacts made from bones, dominated the finds at the Sarqaq levels around Igloolik. These bone artifacts tell of a culture form that was already surprisingly well adapted to life on the arctic coasts, a true "Eskimo culture" with harpoon heads of the same general types as used three thousand years later for seal hunting in the Thule culture and by their present-day successors.

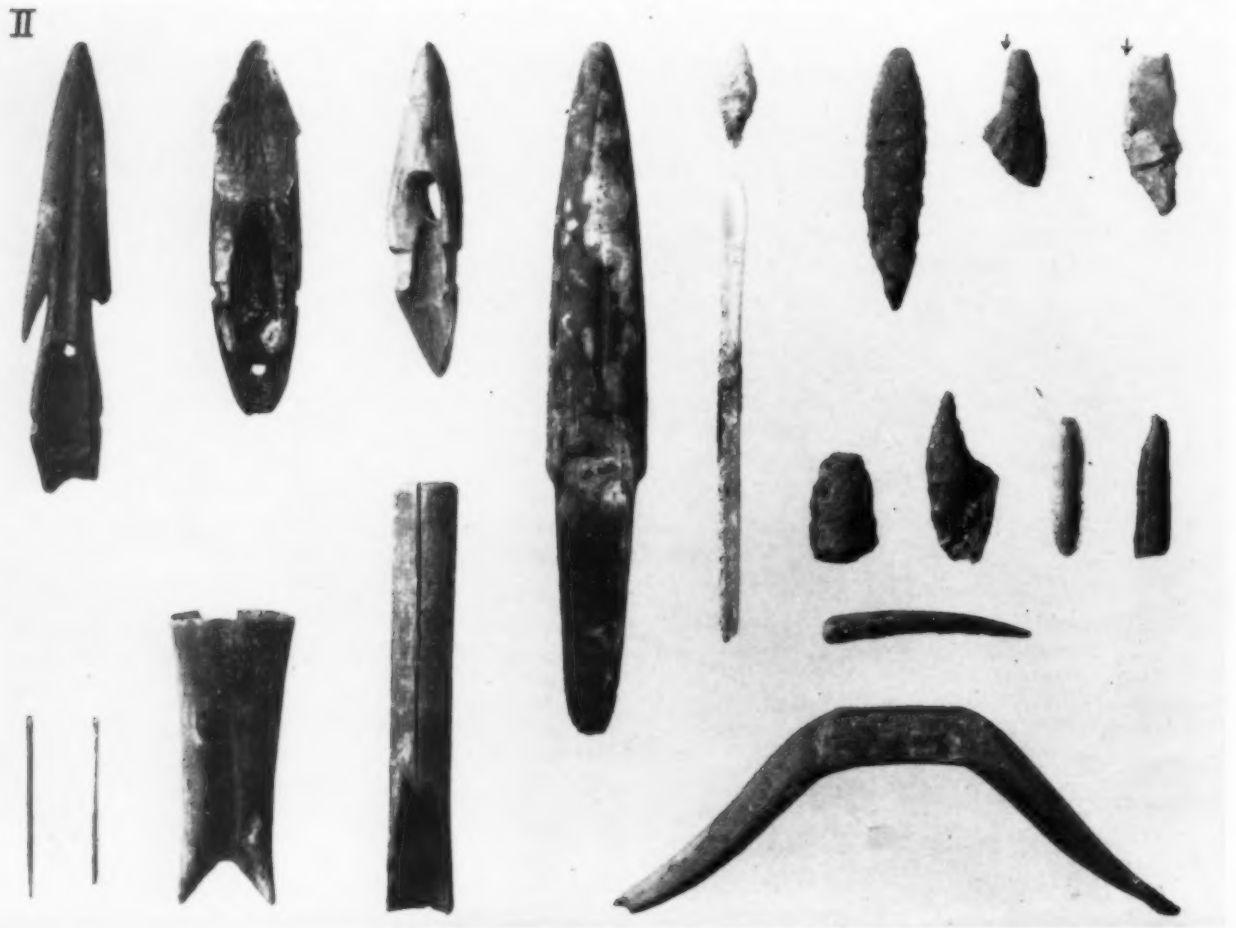
However, the cultural development was not as smooth and gradual as it may seem from a





Artifacts from the Dorset culture, Period II (about 500 B.C.), Jens Munk site.

Artifacts from the Sarqaq culture, Parry Hill site, Igloolik Island, 47-48-metre terraces (about 1900 B.C.).



comparison of the earliest and latest traces. The Sarqaq hunter around 800 B.C. living on the "23-metre terrace" was equipped with the same weapons and utensils as his forefather some twelve hundred years earlier, although, strangely enough, the later implements showed a degenerate and inferior workmanship. The earliest Dorset hunter on the "22-metre terrace", living less than a hundred years later (according to the radiocarbon 14 dates), built his existence only to a small extent on the experiences of the Sarqaq people; without the bow and arrow and the helpful dogs of his predecessors he hunted the caribou with a spear and he managed his transportation problem by pulling the small sledge himself. In the large rectangular houses lighted by a new type of small square stone lamp he produced knives, weapon points and other utensils from a new kind of raw material: slate. And with new double-pointed needles his wife was stitching clothes of a strange pattern: long wide coats with a high collar instead of the customary Eskimo hood.

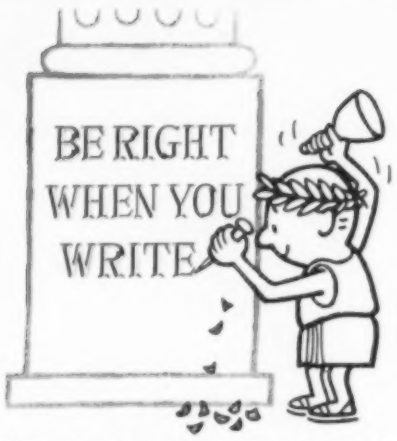
A number of new traits in the early Dorset culture "smells of forest", and on the basis of the Igloolik material it seems to be possible to point out parallels in more southerly cultures, such as the Late Archaic and Early Woodland cultures along the southern limit of the coniferous belt. This, however, does not necessarily mean that the Dorset people were Indians wandering out on the arctic barrens from the forest, but it does indicate very strong influences from that area. And the essential thing is that these "traits" became determining in the formation of the Dorset culture.

The Thule culture people who followed, and conquered the hunting grounds of the last Dorset tribes in the thirteenth century, were Eskimos of old Alaskan extraction. And this fact probably explains the strange relationship to the very earliest Eskimos, the Sarqaq people, traced in the Eastern Arctic about 2000 B.C. They also invaded the area from the west.

* * *

For a detailed description of the results of the Sermermiut excavations, see Meddelelser om Gronland, Vol. 161, Nos. 2 and 3. Copenhagen 1958. A preliminary report on the investigations at Igloolik in 1954 is presented in International Congress of Anthropological and Ethnological Sciences 1956. Philadelphia. A final publication of the 1954 and the 1957 investigations is in preparation.

Father Guy Mary-Rousseliere, O.M.I., mapping the Alarnerk site, 1954.



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EDITOR'S NOTE-BOOK

W. T. Foster (*Forest Protection in Ontario*) is a Forestry graduate of the University of Toronto. He was District Forester at Fort Frances before he assumed his present position, in August 1959, as supervisor of the Forest Protection Branch of the Ontario Department of Lands and Forests. K. B. Turner, in charge of insect and disease investigation and control in the Branch, collaborated in the preparation of the sections on forest insects and diseases.

* * *

James S. Shackleton (*The Craven District of Britain*) was born in Lancashire and has been familiar with Malham Cove from his childhood. He graduated in geology from Imperial College, University of London, and obtained his M.Sc. degree from the University of Saskatchewan. He is now at the University of Liverpool, where he is preparing a thesis for his doctorate based on field work in the Pennines.

* * *

Jörgen Meldgaard (*Origin and Evolution of Eskimo Cultures in the Eastern Arctic*) is on the staff of the Division of Archaeology of the National Museum of Denmark in Copenhagen. He has participated in, or conducted, archaeological field work in north-east Greenland, south-west Greenland, the Canadian eastern Arctic and Denmark. His Arctic investigations constitute a significant contribution to the old and admirable tradition of Danish research in the north polar regions.

AMONGST THE NEW BOOKS

The Oak Island Mystery

by R. V. Harris

(Ryerson Press, Toronto. $4.00)

It is not difficult to believe that a rich treasure was once buried deep on Oak Island in Mahone Bay, Nova Scotia. It is, however, hard to understand why modern engineering methods have failed to uncover it if it is still there. Some of the schemes for locating it sound quite workable, and for each one to fall short of completion gives reason to wonder why.

In 1795, the discovery of some sort of great pit was made on Oak Island, and for over a century and a half men have been trying to clear up the mys-

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tery of it. Mr. Harris goes into considerable detail about each attempt to recover the treasure that supposedly was left in the pit by pirates. He quotes extensively from newspaper accounts, magazine articles, and letters, documenting the known facts so carefully that the reader is led to believe that everything contained in this volume is based on proven material. However, some of what is presented is speculation. Still, one cannot help but agree with the author that the pit, with its protective inlets from the sea, was built for an important purpose. Will we ever know what that purpose was?

A book on seeking buried treasure should excite a large audience, but the author has failed to do more than present statistics and logical possibilities. Not one of the adventurers, including the man who commissioned Mr. Harris to write the account of Oak Island, has more than two dimensions. Consequently, the reader does not get hopeful for their success. No event, even the caving in of walls, is presented in a dramatic way, so the reader does not feel a sense of catastrophe. A writer with some flair for personalizing his material could stir his readers more, though it is doubtful if he could be any more careful in setting forth his facts. CHARLES PAUL MAY

Alaska: The Land and The People
by Evelyn I. Butler and George A. Dale
(The Macmillan Company, Toronto. $4.00)

For young readers, this is a first-rate introduction to an appreciation of the latest addition to statehood. For older readers, its appeal lies in the nearly one hundred surprisingly professional and well-chosen photographs.

The authors, husband and wife, served for fifteen years in education and welfare work with the Alaskan Native Service, the territorial Bureau of Indian Affairs. Much travelling in the outlying areas familiarized them with the facet of Alaskan life which makes up the heart of this book — the small ports and the Eskimo and Indian villages. The first chapter provides a too brief summary of Alaska's position in "the Neighbourhood of Nations", and the last chapter a short description of the larger settlements. Unlike a textbook, this book includes neither statistical tables nor distribution maps, and it avoids political, economic and geographical analysis. It is pure description, written by experts, and by not attempting more, it succeeds in its limited objective of presenting an accurate, though simplified, panorama of Alaskan life. J. KEITH FRASER

Unconventional?

Yes, but conventions change and the *Canadian Geographical Journal* records the progress made. Our picture is from "The Story of Helicopters in Canada", a feature in the March issue.

This is only one of a wide selection of articles available to our members through the Society's official publication, *Canadian Geographical Journal*. Membership in the Society is open to all persons interested in geography in the wider sense—the story of our land and how we live in it.

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Recently Received from Publishers

A Regional Geography of Western Europe. By F. J. Monkhouse. (Longmans, Green and Company, Toronto). France and the Benelux countries are treated in this volume which is the sixth in the series of Geographies for Advanced Study.

* * *

Circumpolar Arctic Flora. By Nicholas Polunin. (Oxford University Press, Toronto). A comprehensive reference text on vascular plants of the Arctic regions, profusely illustrated by line drawings.

Industrial Complex Analysis and Regional Development. By Walter Isard *et al.* (John Wiley and Sons, Inc., New York, and The Technology Press). This book develops by means of a case study a technique for comparing the locational advantages and disadvantages of regions relative to the operation of a set of strongly interrelated industrial activities. The case study chosen to illustrate the analytical method in detail is of the oil refinery, petrochemical and synthetic fibre complexes in Puerto Rico.

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